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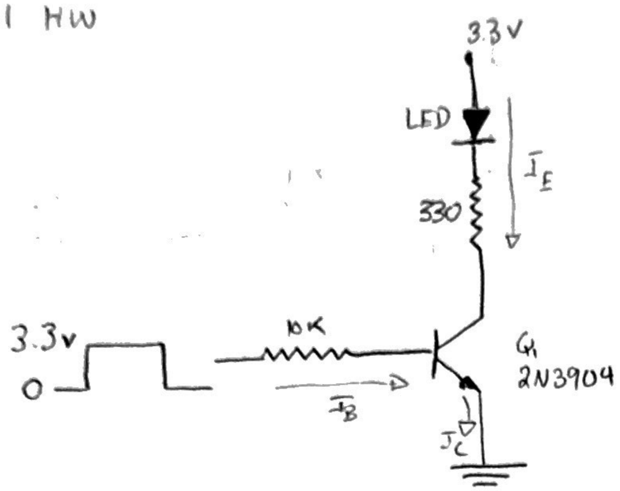
Dr. Hasterman
PHYS 251 HW

HW 6
2.1, 2.4, 2.5

3/3

2.1



$I_c = I_B + I_E$

a.) loop 1

$3.3v - 0.6V - I_E(330) = 3.19v$

$2.7v - I_E(330) = 3.19v$

$I_E(330) = 0.49V$

$I_E = 1.4mA$

loop 2:

$3.3v - I_B(10k) = 3.19v$

$I_B(10k) = 0.11v$

$I_B = 1.1 \times 10^{-5} A$

$I_C = 1.5mA$

$I_{LED} = 1.4mA$

b.) β ?

$V_{out} = \frac{R_2}{R_1+R_2} V_{in}$

$V_{out} = 3.19v$

$V_{out} = \frac{\beta R_2}{R_1 + \beta R_2} V_{in}$

$\frac{V_{out}}{V_{in}} = \frac{\beta R_2}{R_1 + \beta R_2}$

$\frac{V_{out}}{V_{in}}(R_1 + \beta R_2) = \frac{\beta R_2}{R_1}$

$\frac{V_{out}}{V_{in}} R_1 + \frac{V_{out}}{V_{in}} \beta R_2 = \frac{\beta R_2}{R_1}$

$\frac{V_{out}}{V_{in}} R_1 = \frac{\beta R_2}{R_1} - \beta R_2 \frac{V_{out}}{V_{in}}$

$\frac{V_{out}}{V_{in}} R_1 = \beta R_2 \left(\frac{1}{R_1} - \frac{V_{out}}{V_{in}} \right)$

$\frac{\frac{V_{out}}{V_{in}}}{\frac{1}{R_1} - \frac{V_{out}}{V_{in}}} = \beta R_2$

$\frac{\frac{V_{out}}{V_{in}}}{\frac{1}{R_1}} - 1 = \beta R_2$

$\frac{R_1 V_{out}}{V_{in}} - 1 = \beta R_2$

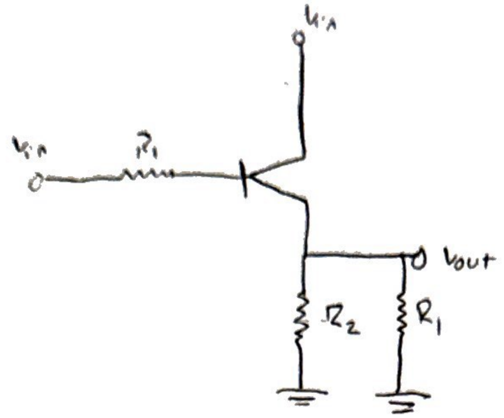
$\beta = \frac{\frac{R_1 V_{out}}{V_{in}} - 1}{R_2}$

$\beta = \frac{\frac{330(3.19v)}{3.3} - 1}{10K}$

$\beta = \cancel{100}$

2.4] .

Z_{out} must be < Z_{in}



To make sure the output is as close to the input as possible, the β factor must be introduced to compensate for the new resistance.

$$\Delta I_E = \Delta V_B / R$$

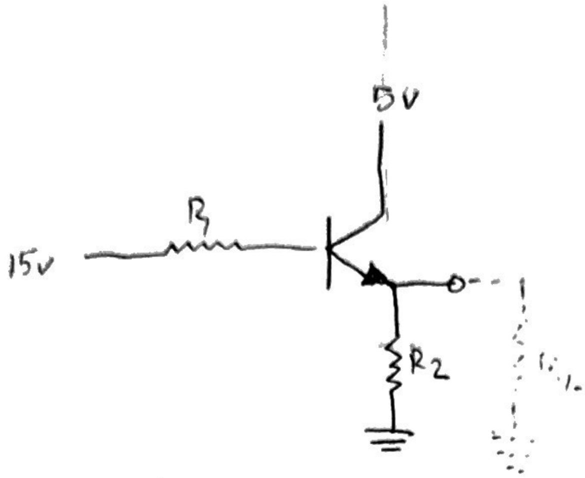
$$\Delta I_B = \frac{1}{\beta+1} \Delta I_E = \frac{\Delta V_B}{R(\beta+1)} \quad \frac{\Delta V_E}{R_{source}}$$

$$R(\beta+1) = \frac{\Delta V_B}{\Delta I_B}$$

$$R(\beta+1) = r_{in}$$

$$Z_{in} = (\cancel{\beta+1}) Z_{out}$$

251.



$R_1 = 95$
$R_2 = 10K$

With such a big difference in the R's, the Vout should be right about what Vin is. which is 15V.

$R_1 = 95$
$R_2 = 10K$